

Article

AHP-SWOT-Based Factors for Optimising Material Handling in China High-Rise Buildings

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Abstract

Material handling (MH) plays a critical role in the performance, cost efficiency, and sustainability of high-rise construction projects. Despite its significance, MH practices in such projects remain challenged by complex vertical logistics, space constraints, fragmented supply chains, and increasing pressure to align with decarbonisation goals. This study applies a mixed-methods approach that integrates a systematic literature review, semi-structured expert interviews, and a SWOT–AHP (Strengths, Weaknesses, Opportunities, Threats—Analytic Hierarchy Process) model to identify and prioritise factors influencing MH optimisation in China’s high-rise construction sector. Eighteen factors were evaluated across four SWOT dimensions, and expert pairwise comparisons were aggregated using geometric means. The results revealed that Technological Adoption (S1) and Technological Advancements (O3) are the most critical enablers, while High Implementation Costs (W2) and Resource Scarcity (T3) are the most significant constraints. Interactions among these factors highlight the dual importance of internal digital capabilities and external technological trajectories in shaping MH strategies. Comparative analysis with practices in Europe, the United States, and the Middle East demonstrates that digitalisation, financial mechanisms, and policy incentives are globally consistent drivers of MH innovation. The findings advance theoretical understanding by integrating perspectives from the Resource-Based View, Technology–Organisation–Environment, and Institutional Theory, and they offer practical implications for policymakers and industry stakeholders seeking to align MH optimisation with China’s dual-carbon targets. This study contributes to the development of a comprehensive decision-support framework that enhances the sustainability, resilience, and efficiency of material logistics in high-rise construction projects.

Keywords: material handling; high-rise buildings; SWOT; AHP; BIM

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1. Introduction

1.1. Background and Research Context

Material handling (MH) is one of the most fundamental yet complex operational processes in construction projects, directly influencing productivity, cost efficiency, safety performance, and environmental impact [1]. It encompasses the planning, transportation, storage, and control of materials and equipment throughout the construction life cycle, from procurement to on-site distribution. In the context of high-rise construction, MH